

On the Causes of and Long Term Changes in Eurasian Heat Waves

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The MERRA reanalysis, other observations, and the GEOS-5 model have been used to diagnose the causes of Eurasian heat waves including the recent extreme events that occurred in Europe during 2003 and in Russia during 2010. The results show that such extreme events are an amplification of natural patterns of atmospheric variability (in this case a particular large-scale atmospheric planetary wave) that develop over the Eurasian continent as a result of internal atmospheric forcing. The amplification occurs when the wave occasionally becomes locked in place for several weeks to months resulting in extreme heat and drying with the location depending on the phase of the upper atmospheric wave. Model experiments suggest that forcing from both the ocean (SST) and land play a role phase-locking the waves. An ensemble of very long GEOS-5 model simulations (spanning the 20th century) forced with observed SST and greenhouse gases show that the model is capable of generating very similar heat waves, and that they have become more extreme in the last thirty years as a result of the overall warming of the Asian continent.

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